

- B2 5. (once amended) An integrated circuit of claim 4, wherein the conductive material of the liner comprises ~~[material has]~~ a random grain orientation or amorphous character.

REMARKS

Status of Application

Claims 1- 5, 7, and 9-15 are pending in the subject application. Claims 6 and 16-27 have been withdrawn from consideration without prejudice.

Rejection based on 35 USC § 112

Claims 1-5 and 7-15 are rejected under 35 USC § 112 as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention. In particular, Examiner states that the phrase "to improve electromagnetic lifetime of the conductor" vague and indefinite. Per Examiner's suggestion, Applicants amended claim 1 to recite "to improve electromigration lifetime of the conductor and respectfully request withdrawal of the rejection based on 35 USC § 112.

Rejection based on 35 USC § 103

Claims 1-5, 7, and 10-14 are rejected based on 35 USC § 103 as being obvious over the present admissions of prior art of record taken with Sumi. Applicants respectfully disagree.

Claim 1, as amended, recites a conductor located in a damascene structure having sidewalls and bottom lined with a liner layer. The liner layer, by contacting first, second and third surfaces of the conductor, imparts a random grain orientation in the conductive material of the conductor to improve its electromigration lifetime.

Sumi et al. (Sumi), on the other hand, discloses lining the bottom surface of an Al conductor with a Ti/TiN dual barrier layer wherein the upper TiN layer is converted to an amorphous layer to enhance the barrier properties of the layer by destroy the crystal grain boundary which functions as an Al diffusion path. Sumi nowhere teaches a conductor with random grain orientation by lining first, second, and third surfaces of the conductor to improve the electromigration lifetime of the conductor.

Furthermore, Applicants submit that the conventional wisdom teaches away from the present invention. As stated in the application, "depositing the conductive material such that it

has a uniform (111) grain orientation improves the film's reliability...." See specification at page 2, lines 3-5; L.M. Ting and Q-Z. Hong, "Electromigration Characterization for Multilevel Metallizations using Textured AlCu", Materials Research Society Symposium Proceedings, Vol 428, pp.75-80 (1996); D.B. Knorr and K.P. Rodbell, "The Role of Texture in the Electromigration Behavior of Pure Aluminum Lines", J. Appl. Phys. Vol. 79, pp.2409-2417 (1996); and C. Ryu, A.L. Loke, T. Nogami and S.S. Wong, "Effect of Texture on the Electromigration of CVD Copper", IEEE International Reliability Physics Symposium 97CH35983, pp.201-205 (1997). As such, one skill in the art would specifically avoid forming a conductor with random grain orientation to improve electromigration lifetime by lining sidewalls and bottom of a damascene structure with a liner having, for example, amorphous character or random grain orientation. Therefore, Applicants submit that the cited art and admitted prior art of record, alone or in combination, fail to teach or suggest the claimed invention and respectfully request withdrawal of the rejection of the claims based on 35 USC § 103.

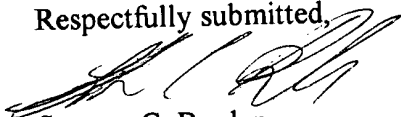
Conclusion

In view of the foregoing, Applicants believe that all claims now pending in this application are in condition for allowance. The issuance of a formal Notice of Allowance at an early date is respectfully requested.

Should the Examiner believe that a telephone conference would expedite prosecution of this application, please telephone the undersigned attorney at his number set out below.

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Respectfully submitted,



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